of igneous matter and other phenomena due to this cause are considered in the present paper.—An expedition to the Maldives, by A. Agassiz. The most important result of the expedition was the contribution to our knowledge of atoll formation. The present definition of atolls appears to be unjustifiable, as there is every possible gradation between a curved open crescent-shaped bank of greater or less size and an absolutely closed ring of land surrounding a lagoon without direct communication with the sea.—The flower-like distortion of the coronas due to graded cloudy condensation, by C. Barus.—Varying degrees of actinism of the X-rays, by J. O. Heinze, jun. It was found that the rays which are the most active in producing fluorescence are not those which act most vigorously in the photographic plate, and hence that the maximum effect on a platinocyanide screen does not coincide with the greatest photographic effect.

Bulletin of the American Mathematical Society, March.—The application of the fundamental laws of algebra to the multiplication of infinite series, by Prof. F. Cajori. Following up his previous work (see *Transactions* of the Society, vol. ii. pp. 25–36, and *Science*, vol. xiv., September 13, 1901) and also Pringsheim's (also in vol. ii. of the *Transactions*, pp. 404–412), Prof. Cajori here establishes a class of series with real terms which possesses the property of his former paper, but which seems to be distinct from the class given by Pringsheim. He then considers the validity of the fundamental laws in the multiplication of these infinite series, and next he points out another method for obtaining divergent series whose product is absolutely convergent. Lastly he generalises a theorem of Abel on the multiplication of series.—Dr. Fite gives a notelet concerning the class of a group of order p^m that contains an operator of order p^{m-2} or p^{m-3}, p being a prime.—Dr. Epsteen contributes a proof that the group of an irreducible linear differential equation is transitive.—Another short note follows by Dr. Eisenhart, on lines of length zero on surfaces.—Dr. Kasner, writing on some properties of potential surfaces, extends some of the results of a previous paper (*Bulletin*, vol. vii. pp. 392–9) to the surfaces expressed in rectangular coordinates by an equation $\phi(x, y, z)=0$, where ϕ is a rational integral solution of the potential equation $\Delta\phi \equiv \frac{\delta^2\phi}{\delta x^2}+\frac{\delta^2\phi}{\delta y^2}+\frac{\delta^2\phi}{\delta z^2}=0$. The last four notes were read before the Society and have numerous useful references.—Prof. Osgood gives an extended review of Prof. G. A. Gibson's "Elementary Treatise on the Calculus," in which he remarks that though many teachers may not see their way to use it as a text-book during the early part of the course, yet the book can be commended for collateral reading from the very beginning, and that teachers will have to consider whether it may not be taken as the chief text-book in the second course.—Further short notices follow of Cahen's "Éléments de la Théorie des Nombres" and of R. Dedekind's "Essays on the Theory of Numbers" (Beman's translation) by Prof. L. E. Dickson, and of the "Annuaire pour l'An 1902" by Prof. E. W. Brown.

Memoirs of the St. Petersburg Society of Naturalists, Botany, vol. xxx.—On parasite fungi found in the neighbourhoods of St. Petersburg, by K. S. Ivanoff. List of 153 species, with a few remarks.—Critical review of the flora of Moscow, by A. N. Petunnikoff. Second part, continued from *Botanicheskiya Zapiski*, part xiii., 1896; full summary in German.—Botanical researches in the province of Orel, by M. D. Zalessky; summary in German. A portion of this paper is given to a detailed description of a Scotch-fir forest on a Loess soil, which is a rare case in Russia, and which the author explains in accordance with the views of Litwinow (*Bull. Soc. Nat. Moscou*, 1890, No. 3) on the survival of fir forests during the great Pleistocene glaciation.—On dormant buds, by W. Lubimenko, with twenty-nine figures; summary in German.—Exploration of the flora of Pskov in 1899–1900, by N. Puring.—The flora of the Polyesie, by Joseph Paczosski, continued. The Monocotyledones, Nos. 951 to 1291, are now given, and this most valuable work is thus concluded.

Vol. xxxi.—The whole of this volume is given to the first and the second fascicules of "Flora Caucasica Critica," by N. Kuznetsoff, N. Busch and A. Fomin. The intention of the authors is to give, in a series of monographs disposed in the same system as in A. Engler's "Pflanzenfamilien," the necessary materials for an abridged "Flora of the Caucasus." This latter would be for general use, while the present work must be a sort of preparatory work for specialists only. The successful accomplishment of this grand undertaking seems to be guaranteed—the editor, Prof. Kuznetsoff, having reasons to believe that the work will find the support of specialists. We may remark that under the heading of habitus we find for certain species extremely valuable and most interesting descriptions, which will be welcome to both the systematist and the geographer. The present volume includes the Pirolaceæ, Ericaceæ and Primulaceæ, by Kuznetsoff, and the Nymphaceæ, Ceratophyllaceæ and Ranunculaceæ, by Busch.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 28, 1901.—"A Comparative Study of the Spectra, Densities and Melting Points of some Groups of Elements, and of the Relation of Properties to Atomic Mass." By Hugh Ramage, B.A., A.R.C.Sc.I., St. John's College, Cambridge. Communicated by Prof. G. D. Liveing, F.R.S.

The properties of nineteen elements were studied, namely:—(1) Lithium, sodium, potassium, rubidium, cæsium; (2) copper, silver, gold; (3) magnesium, zinc, cadmium, mercury; (4) calcium, strontium, barium; (5) aluminium, gallium, indium and thallium. The flame spectra of the metals are much simpler than the arc or spark spectra; they may be regarded as the fundamental spectra of the metals. They furnish purely experimental data with which to begin an investigation of the laws which govern the distribution of lines in spectra and by which to study the relations of the physical and chemical properties of the metals to their spectra. Diagrams were drawn with the oscillation frequencies of the lines in the fundamental spectra, or the densities, or the melting points, of the metals as abscissæ, and the atomic masses, or a function of these, as ordinates. Two diagrams of spectra are reproduced in the paper. The corresponding lines in homologous spectra were joined by lines some of which are straight, but most are curved. The densities and melting points were connected in a similar way.

The following facts have been observed in the study of the diagrams:—

(1) The metals considered may be classified into groups according to the characters of their spectra. The elements in each group appear to have a similar atomic constitution.

(2) The connecting lines between the members of the chemical groups are not continuous; there are certain breaks in them. These occur between the metals sodium, magnesium and aluminium, and the metals of their respective groups with higher atomic masses. The break between the sharp series in the spectra of the aluminium group is very slight; that between the diffuse series is very marked and corresponds to marked changes in the densities and melting points of these elements.

(3) The cause of the displacement of corresponding lines in some strictly homologous spectra is intimately connected with the atomic masses. The shift of the subordinate series of potassium, rubidium and cæsium is approximately proportional to the atomic mass, whilst the shift of the principal series is very nearly proportional to the square of the atomic mass.

(4) The second diagram, drawn from the spectra and the squares of the atomic masses, shows that the lines which connect the corresponding members of homologous doublets and triplets approach one another as the atomic mass decreases and intersect on the line of zero atomic mass.

The spectra of potassium, rubidium and cæsium change regularly with the atomic mass, and it should be possible to express the series in these spectra by a formula in which the atomic mass is the only variable. There are obvious difficulties in modifying Kayser and Runge's formula in this way, but Rydberg's formula is more general and the constants are more easily calculated. Rydberg's formula and method give better results for the subordinate series than for the principal series; also for the series in the spectra of elements of low atomic mass than for those of high. The best results were obtained for the principal series of the three metals when in Rydberg's general formula

$$n = n_\infty - \frac{N_0}{(m+\mu)^2}$$

we substituted

$$n_\infty = 35349 - aW^2;\ N_0 = 109675$$

and

$$\mu = \{1{\cdot}19126 + 0{\cdot}00103W + (0{\cdot}04377 + 13W^2 \times 10^{-7})(1 - 3^{1-m})\},$$

where

$n = 10^8\lambda^{-1}$; $a = 0{\cdot}2233$; W = atomic mass, and $m = 1, 2, 3 \ldots$

This formula gives the second principal series of the three metals; the first principal series are obtained by increasing the value of μ by $182W^2 \times 10^{-8}$. The agreement between the observed and calculated numbers is very close. The formula, though empirical, involves only seven adjustable constants, and it represents in the table, given in the paper, thirty-two lines. It thus affords striking evidence for the fundamental identity of type of the spectra of the three metals to which it applies, and indicates that their differences depend on the atomic mass alone. This evidence is further strengthened when it is remembered that, being only an approximation to an unknown formula, it will naturally come nearer it for large values of m than for small ones. Additional evidence supporting these views is given by the above observations upon the subordinate series of these three metals. The fundamental lines in the spectra of calcium, strontium and barium are given by the formula

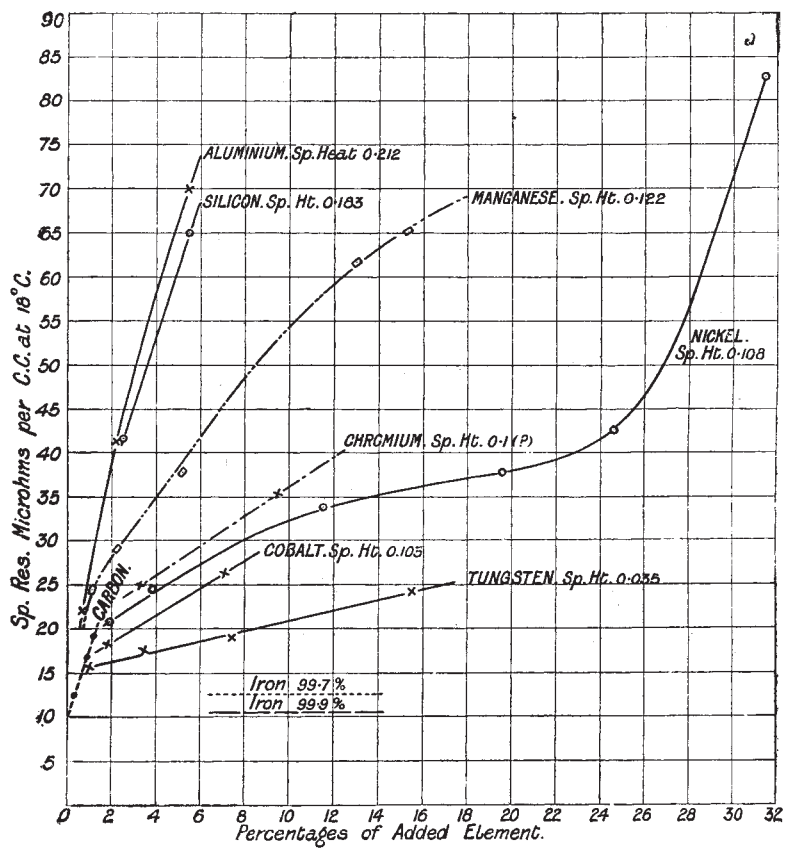
$$n = 24170 - 0{\cdot}3232W^2.$$

Many points of interest are revealed by a study of these diagrams, but perhaps the greatest interest lies in the comprehensive view one gets of the order of change in the properties of the elements. The diagram of densities is easier to understand than that of melting points, and the double connections in it, from sodium to potassium and copper, from magnesium to calcium and zinc and from aluminium to scandium and gallium, are seen to be quite natural. The changes in some of the corresponding lines in the spectra agree with the changes in the densities and melting points of the elements. Other lines in the same spectra change in a manner which is independent of these.

The whole study indicates that the properties of the elements are fundamentally due to the structure of the atoms as revealed by their spectra rather than to the quantity of matter in them. It seems, for instance, inconceivable that the transition from calcium to strontium proceeded through the intermediate elements when we consider that the strontium atoms must have a similar structure to those of calcium, and that this structure is so simple that the fundamental spectrum of each of these elements consists of a single line. The anomaly, according to Mendeléeff's law, in the atomic masses of tellurium and iodine is further evidence of this. The genesis was not in the direction of tellurium to iodine, but from, or perhaps through, oxygen and fluorine respectively.

February 6.—On the increase of electrical resistivity caused by alloying iron with various elements to the specific heat of those elements. By Prof. W. F. Barrett, F.R.S.

In this paper the author draws attention to a connection which appears to exist between the electric conductivity of certain alloys of iron and the specific heats, and hence atomic masses, of the particular elements with which the iron is alloyed. In previous memoirs, the author, in conjunction with Mr. W. Brown, has determined the electric conductivity and magnetic permeability of 110 different alloys of iron prepared with great care by Mr. R. A. Hadfield, of Sheffield.[1] The results of these experiments show (1) that the conductivity of iron is diminished by alloying it with another metal even though that metal be a much better conductor than iron; (2) that this reduction of conductivity is not related to the resistivity of the added metal; on the contrary, an alloy of very high specific resistance can be produced by adding to iron an element of much lower specific resistance than the iron itself, *e.g.* the metal aluminium is upwards of three times better a conductor than iron, yet the addition of 5 per cent. of aluminium to iron makes the conductivity of the alloy five times worse than iron; (3) the greatest reduction in conductivity in a given alloy is produced by the first increments of the added element. This is shown in the accompanying diagram, where the specific resistances of some of the alloys examined (deduced from their conductivities), are plotted against the percentages of the added element: the specific resistance of iron alone being shown by the horizontal dotted lines, the upper containing 0·3 and the lower only 0·1 per cent. of carbon and other foreign bodies. The series of fairly smooth curves thus obtained for each alloy are seen to be steepest near their origin, a curious flexure being found in the nickel steels; (4) a relationship does appear to exist between the specific heat of the added element and the resistance of the alloy it forms when united with iron. In the diagram the specific heats of the various elements are placed after their names. Thus the specific resistance of an alloy of 5½ per cent. of aluminium with iron is seen to be 70 microhms, the same amount of silicon with iron 65 microhms, of manganese with iron 38 microhms, of nickel 27 microhms, and of tungsten 18 microhms; now the specific heats of these elements are, aluminium 0·212, silicon 0·183, manganese 0·122, nickel 0·109, and tungsten 0·035. Those elements having high specific heats, and therefore small atomic or molecular masses, produce the greatest increase in electric resistivity of the corresponding alloy with iron.



Dividing the *increase* in electric resistivity by the percentage of the added metal, we obtain the increase in the specific resistance of iron produced by 1 per cent. of the added element

[1] *Scientific Transactions of the Royal Dublin Society*, vols. vii. and viii. "Researches on the Physical Properties of the Alloys of Iron," by W. F. Barrett, W. Brown and R. A. Hadfield.

This is shown for a 2 per cent. alloy (except in the case of carbon) in the second column of the accompanying table, along with the specific heats and atomic weights of the elements named in the first column.

Alloy of iron.	Increase of resistivity for 1 per cent.	Specific heat.	Atomic weight.
Tungsten ...	2·0	0·035	184
Cobalt ...	3·0	0·107	59
Nickel ...	3·5	0·109	59
Chromium ...	5·0	0·1 (?)	52
Carbon[1] ...	5·0	0·160[2]	12
Manganese ...	8·0	0·122	55
Silicon ...	13·0	0·183	28
Aluminium ...	14·0	0·212	27

The author ventures to think that the correspondence shown in columns 2 and 3 of the foregoing table is something more than a chance coincidence. He states, however, that it is necessary to have exact determinations of the resistivity of a larger number of alloys of iron before any definite conclusions can be reached.

A series of experiments is in progress for the measurement of the relative *thermal* conductivity of the foregoing alloys. About forty determinations have been made, and so far the order of thermal conductivity has been found to be the same as that of their electrical conductivity.

As regards the *magnetic permeability* of these alloys, the author states that the order is very different from that of their electric conductivity. The most highly permeable alloys are those formed of aluminium and silicon with iron. In fact, the magnetic permeability of an alloy of iron with 2½ per cent. of silicon exceeds that of the best and purest annealed iron up to a field of 10 C.G.S. units. Still more remarkable is a similar alloy of aluminium and iron; although it contains 2½ per cent. of non-magnetic elements, its magnetic permeability and maximum induction up to a field of 60 units exceeds the best and purest annealed iron, a specimen of Swedish charcoal iron containing 99·9 per cent. of iron, all the specimens having been subjected to a precisely similar annealing process.

It is possible the increased magnetic susceptibility given to iron by aluminium, and to a less extent by silicon, may be due to the strong chemical affinity which these elements have for oxygen, whereby any of this gas which might be dissociated in the molten iron would be removed, and the texture of the metal thus rendered closer and more uniform. In the same way, by combining with the oxygen, they would remove traces of oxide of iron, more or less diffused through all iron, and the presence of which would certainly lower the magnetic susceptibility.

The remarkable magnetic properties of these two alloys, especially of the aluminium-iron alloy, is a matter, not only of considerable theoretical interest, but obviously is also of great practical importance in electrical engineering.

Note added by the Author April 21.

In connection with the increased magnetic permeability produced by alloying iron with a small percentage of aluminium, Principal Hicks draws attention, in the last number of NATURE, to the interesting fact—of which I was unaware, and which I believe has not hitherto been published—that some years ago he noticed this property of aluminium; and he attributes it "to the increased size of the iron crystals" produced by the foreign body. This may be the explanation, but I am disposed to think it is closely allied to the one I have suggested, and with the known metallurgical effect of aluminium on iron, to which Prof. Wilson has drawn attention in his contribution to the discussion at the Institute of Electrical Engineers. W. F. B.

March 20.—"The Equilibrium of Rotating Liquid Cylinders." By J. H. Jeans, B.A., Isaac Newton Student and Fellow of Trinity College, Cambridge. Communicated by Prof. G. H. Darwin, F.R.S.

The most serious obstacle to progress in the problem of determining the equilibrium configurations of a rotating liquid lies in the difficulty of determining the potential of a mass of homogeneous matter of which the boundary is given.

The present paper deals only with two-dimensional problems, and for these a method is developed enabling us to write down the potential by transformation of the equation of the boundary. The method is not of universal applicability, but is adequate to the problem in hand.

As applied to the determination of equilibrium configurations, the method is as follows. Starting from the general equation (in polar coordinates)

$$r^2 = a_0 + 2a_1 r\cos\theta + 2a_2 r^2\cos 2\theta + \ldots,$$

we transform by the substitution $\xi = re^{i\theta}$, $\eta = re^{-i\theta}$, and attempt to solve the resulting equation explicitly for ξ in the form

$$\xi = b_1 + b_2\eta + b_3\eta^2 + \ldots + \frac{c_1}{\eta} + \frac{c_2}{\eta^2} + \frac{c_3}{\eta^3} + \ldots,$$

this solution being such that the right hand shall give the true value of ξ at every point of the surface. Subject to certain limitations, the condition that the surface shall be an equilibrium surface under a rotation ω is found to be given by the system of equations

$$\frac{b_n}{n} = a_n\left(1 - \frac{\omega^2}{2\pi\rho}\right), \qquad (n = 1, 2, 3, \ldots).$$

The linear series of circles and ellipses (corresponding to the Maclaurin spheroids and Jacobian ellipsoids) are investigated without difficulty, and the points of bifurcation on these series are found. The first point of bifurcation on the latter series is shown to lead to a pear-shaped curve, similar to that of Poincaré, and it is shown that an exchange of stabilities takes place at this point. The linear series of which this pear-shaped figure is the starting point is now investigated, the equation being expanded in an ascending series of powers of a parameter θ.

After passing through various pear-shaped configurations, the fluid is found to assume a shape similar to that of a soda-water bottle with a somewhat rounded end. Beyond this the configuration is found to be suggestive of a tennis-racquet with a very short handle. A "neck" gradually forms at the point at which the handle joins the racquet, and this becomes more pronounced, until ultimately the curve separates into two parts.

As we proceed along this series the rotation steadily increases. At the point of bifurcation the value of $\omega^2/2\pi\rho$ is 0·375; when separation takes place this value is about 0·43. It is tolerably clear (although not rigorously proved) that when separation takes place the primary may be regarded as the Jacobian ellipse, corresponding to rotation $\omega^2/2\pi\rho = 0{\cdot}43$, distorted by the tidal influence of the satellite. The linear diameters of primary and satellite are in a ratio of about 4 : 1.

The points of bifurcation on the Poincaré series are not investigated. Since the Jacobian ellipse is known to be stable, there is ground for supposing that the series remains stable up to the point of separation. It therefore appears probable that the primary moves through a cycle of configurations in which Jacobi's and Poincaré's figures alternate. The angular momentum is decreased by about 30 per cent., at the ejection of each satellite.

Royal Astronomical Society, April 11.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—Among the presents announced, special attention was called to Circular No. 9 of the Paris Astrographic Conference, by M. Lœwy, dealing with the accuracy of measures of star images on photographs, and with the planet Eros.—In a third paper on stationary meteor radiants, Prof. Turner considered the possible effect of atmospheric retardation of meteors passing near the earth, concluding that such effect would be so small as to be negligible.—Prof. Turner also read a paper on the relative number of star images photographed in different parts of a plate. Counts of star images on plates taken at Oxford, Paris, Algiers, Toulouse and San Fernando showed that the density of star images in different parts of a plate varied by about 50 per cent. The region of greatest density is not in the centre, but a ring of 35′ to 60′ radius, plates taken at different observatories giving different results. On the other hand, the photographic doublet used for the Cape Photographic Durchmusterung gave sensibly uniform density; it was therefore suggested that the doublet may be the best instrument for star charting.—Dr. Rambaut read a paper by Mr. W. H. Robinson on κ Persei and 36 Persei,

[1] For a 1 per cent. alloy. The molecular weight of carbon would appear to be at least four times its atomic weight if this analogy holds true.

[2] As *graphite*; as *diamond* the specific heat of carbon is 0·113, according to H. F. Weber.

which had recently been announced as variable. Examination of the photographs taken at Oxford appeared to show that the variability of these stars had been assumed on insufficient grounds.—Lantern slides of a Leonid meteor, taken by Prof. Rees and Mr. Post, were shown on the screen.—The secretary partly read a paper by Mr. Whitmell, calling attention to the circumstances on July 17, 1902, when there will occur a transit of the earth over the sun, which will be partially visible to an observer on Saturn through the Cassini division of the ring. At the same time a terrestrial observer, suitably placed, will be able to view, through that division, a portion of the planet's disc lit up by sunlight, so that a part of the division will appear bright instead of dark.—The secretary also partly read a paper by Prof. Barnard on the proper motion of stars in the dumb-bell nebula. The author concluded that the supposed proper motion was not real, but due to inaccuracies in earlier measures of position.

Mathematical Society, April 10.—Dr. E. W. Hobson, F.R.S., president, and, temporarily, Dr. J. Larmor, F.R.S., in the chair.—Dr. Hobson communicated a note on divergent series. After explaining the method by which Borel attaches a definite arithmetical meaning to certain classes of divergent series, by the use of related convergent series, he gave an account of an extension to a wider class of series which are such that the radius of convergence of Borel's related series is zero. This extension involves the use of Bessel's functions of imaginary argument in place of Gamma functions.—Prof. Love gave a preliminary account of some researches concerning stress and strain in two-dimensional elastic systems. Solutions of two-dimensional problems, besides being useful for purposes of illustration, often lead to important results in regard to the strength of long prisms or of thin plates. The strain and displacement can be obtained by the superposition of effects due to singularities of functions of a complex variable; and there are relations between problems connected with prisms of different sections, the areas within the two sections being transformed, one into the other, by a conformal representation.—The following papers were communicated from the chair:—Dr. Baker, Further applications of matrix notation to integration problems. The finite equations of the adjoint group of any continuous group, whether the parameters are canonical or not, are expressed in terms of certain matrices, and it is shown that any transformation of the adjoint group can be resolved into a succession of two transformations respectively of the first and second parameter groups. A formula is obtained for the general integral of any set of simultaneous linear differential equations with variable coefficients, in a form valid for the whole of the Mittag-Leffler star region over which the integrals exist. The method of obtaining this formula can be applied to establish the existence of, and to calculate, the integrals of a system of differential equations with real independent variables, the coefficients in the equations being integrable functions, but not necessarily continuous functions.—Dr. L. E. Dickson, The groups defined for an arbitrary field by the multiplication tables of certain finite groups. The object of the paper is to discuss, for all the cases that arise, the groups defined by certain simple types of finite groups. The methods employed are quite elementary and are practically independent of the general theory, as worked out by Frobenius and Burnside. Illustrations are given of a general method of determining the irreducible factors of the group-determinant.—Prof. T. J. I'A. Bromwich, The convergence of series that represent a potential. It is shown that the harmonic series by which the potential of a body at an external point can be represented, in the neighbourhood of the point, converges generally at points within the body. The nature of the domain of convergence is determined, and illustrated by examples.

Royal Meteorological Society, April 16.—Mr. W. H. Dines, president, in the chair.—Captain D. Wilson-Barker delivered a lecture on clouds. After some remarks on the composition and the height of the atmosphere, the lecturer said that until recent years comparatively little scientific attention had been paid to the subject of clouds. This he largely attributed to the lack of a simple practical classification. The French naturalist Lamarck was probably the first to formulate one, but Luke Howard, a London merchant, about 1802 introduced the first practical classification, which is still in use among many observers. Clouds are formed by one of two causes, viz. (1) the mixing of two masses of moist air of unequal temperatures; or (2) through changes occurring in the atmosphere, where expansion and consequent loss of heat take place, causing condensation of moisture. Captain Wilson-Barker said that a simple primary classification is best arrived at by a two-fold division of cloud types, viz. (1) "stratus," or sheet clouds, and (2) "cumulus," or heap clouds. The former may be roughly considered the cloud of a settled and the latter of an unsettled state of the atmosphere. He showed by means of lantern slides a number of cloud pictures illustrating certain varieties of both main types. Under "stratus," or sheet cloud, the lecturer included fog stratus, high stratus, cirro-cumulus, cirrus, nimbus and scud; and under "cumulus," or heap clouds, he included the ordinary cumulus, the shower cumulus, the squall cumulus and roll cumulus.

PARIS.

Academy of Sciences, April 14.—M. Bouquet de la Grye in the chair.—The president announced the death of M. Alfred Cornu, member of the section of physics.—Researches on electromotive forces, by M. Berthelot. A discussion of the relations between the heats of dilution and the electromotive force of concentration cells. From twenty-four to forty-eight concentration cells of sodium chloride were placed in series, the electromotive force of which, measured by the usual open circuit methods, was 5–7 volts; it was not, however, found possible to decompose water by such a battery.—On the fundamental theorem of the theory of Abelian functions, by M. Paul Painlevé. An elementary and direct demonstration is here given, depending on the ordinary theory of functions of one variable.—The resistance due to companion waves, by M. de Bussy. It is shown by reasoning based partly on the author's own experiments and partly on those of Froude, that in a ship the form of which corresponds to the maximum speed the resistance due to the companion waves varies as the sixth power of the speed.—Principle of a new interference refractometer, by M. G. Sagnac. An arrangement of Fresnel's mirrors is described giving circular fringes without the use of a slit. It would appear to be preferable to the arrangement of Michelson in the case where it is necessary to have a temperature rigorously the same in the corresponding regions of the two interfering bundles.—Some remarks on the theory of Duddell's singing arc, by M. Paul Janet. The singing arc discovered by Duddell furnishes a means of obtaining an alternating current by means of a continuous electromotive force. The distribution of the energy and the values of the current in the different parts of the circuit are worked out and a summary of the results given.—Variations in spark spectra, by M. B. Eginitis. On sparking between poles of two metals, a gradual increase in the self-induction of the spark circuit frequently resulted in the elimination of the spectrum of one of the metals. It was not found possible to eliminate the spectrum of mercury, sodium and potassium in this way.—Retrograde diffusion of electrolytes, by M. J. Thovert. Measurements are given of the diffusion of a solution of an electrolyte containing an acid with the same negative ion into a solution of the electrolyte alone. The results were in complete accord with the electrolytic diffusion theory of Nernst.—Contribution to the theory of the dynamo, by M. N. Vasilesco-Karpen.—Remarks on the working of coherers and auto-decoherers, by M. O. Rochefort. It has been found by experiment that all coherers with spontaneous decohesion may be reduced to the state of ordinary coherers by diminishing the pressure of the imperfect contacts; sufficient experimental data have not yet been accumulated as regards the reciprocal of this. It has, however, been found that in certain cases with metal-metal or powder contacts the radio-conductor can be brought to the state of auto-decoherers by simple increase of pressure.—Luminous sensation as a function of the time, by MM. André Broca and D. Sulzer.—Values of the electrical resistance, the index of refraction and of the rotatory power of normal blood serums, by MM. Dongier and Lesage. With a view of utilising various physical methods for the study of certain pathological cases, data were accumulated for more than 200 samples of blood serum, care being taken to collect from only healthy subjects.—On the composition of gaseous hydrates, by M. de Forcrand. After remarking on the experimental difficulties in the determination of the exact composition of the hydrates of such a gas as sulphur dioxide, the author develops a new method based on the fixed ratio between the heat of formation of the solid hydrate and the absolute temperature at which this hydrate has a pressure of 760 mm.—The action of hydrogen upon strontium amalgam, by M. Guntz. The dissociation pressures of strontium hydride are measured at

various temperatures, and by the application of the formula of Clapeyron to the data thus obtained, the heat of formation of the hydride is calculated, and compared with the value given by direct experiment. From these experiments it was also possible to give the exact conditions necessary to the preparation of metallic strontium from its amalgam.—On the combinations of alumina with chromium sesquioxide, by M. Duboin.—On the composition of the amidotariric acids, by M. Arnaud. The application of Beckmann's reaction to tariric ketoxime gave undecylamine, pimelic acid, lauric acid and amidocaproic acid, from which the formula $CH_3—(CH_2)_{10}—C\equiv C—(CH_2)_4—CO_2H$ is deduced for tariric acid.—On diacetylbenzoylethane and acetylmethylphenylfurfurane, by M. F. March.—On methoethenylbenzene, by M. M. Tiffenau.—On oxyisopropylphosphinic acid, by M. C. Marie.—The action of the organo-magnesium compounds on the β-ketonic esters, by M. V. Grignard. Acetoacetic ethyl ester reacts with magnesium methyl iodide entirely in the enolic form; its mono-alkyl derivatives appear to behave as a mixture of the enolic and ketonic forms; the product of condensation of acetoacetic ester with aldehydes react with the magnesium alkyl compounds in a manner corresponding to the formula of Classen.—On the ichthyological fauna of the basin of the Adour, by M. G. de Saint-Paul.—On the epithelioglandular origin of the seminal cells, by M. G. Loisel. The conclusion is drawn from the experiments cited that in all vertebrates, including mammals, birds, reptiles and fishes, the seminal cells are derived from a glandular epithelium.—On the generic identity of *Zygodia axillaris* and the *Baissea*, by M. Henri Hua.—The treatment of rickets by cod liver oil containing lecithin, by M. G. Carriere. The cod liver oil used contained 0·41 per cent. of lecithin derived from eggs, and was applied in five cases, with the result that the disease was arrested and cured in from four to six months.—Researches in the variations arising in the toxic power of certain mineral and organic compounds, according to the chemical groups to which they are linked in their soluble compounds, by M. Marc Laffont.

DIARY OF SOCIETIES.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—On Skin-currents. Part III.—The Human Skin: Dr. A. D. Waller, F.R.S.—Antarctic Origin of the Tribe Schœneæ: C. B. Clarke, F.R.S.—A New Interpretation of the Gastric Organs of *Spirula Nautilus* and the Gastropods: J. E. S. Moore and W. B. Randles.—Absolute Magnetic Observations at the Valencia Observatory (Cahirciveen, Co. Kerry), 1899, 1900 and 1901: J. E. Cullum.

ROYAL INSTITUTION, at 3.—The Oxygen Group of Elements: Prof. J. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Problems of Electric Railways: J. Swinburne and W. R. Cooper. (Adjourned discussion).—Form of Model General Conditions, for use in connection with Contracts for Plant, Mains, and Apparatus for Electricity Works. As drafted by a Committee.

FRIDAY, APRIL 25.

ROYAL INSTITUTION, at 9.—X-Rays and Localisation: Dr. J. Mackenzie Davidson.

PHYSICAL SOCIETY, at 5.—An Exhibition of a Mechanical Break for Induction-coils: Dr. Dawson Turner.—A Temperature Indicator for use with Platinum-thermometers, in which Readings are Automatically Reduced to the Gas Scale: R. S. Whipple.—Note on the Compound Pendulum: S. A. F. White.

INSTITUTION OF CIVIL ENGINEERS, at 4.—Sir W. C. Roberts-Austen, K.C.B., F.R.S., will repeat the "James Forrest" Lecture on Metallurgy in Relation to Engineering.

MONDAY, APRIL 28.

SOCIETY OF ARTS, at 8.—Glass for Optical Instruments: Dr. R. T. Glazebrook, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Trade Routes in Eastern Persia: The Earl of Ronaldshay and Edward Penton.

INSTITUTE OF ACTUARIES, at 5.30.—Vaccination and the Act of 1898: A. F. Burridge.

TUESDAY, APRIL 29.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Stone Axes and other objects from Queensland: R. D. Darbishire.—Notes on the "Goura," the Musical Instrument of the Bushmen and Hottentots: H. Balfour.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 30.

SOCIETY OF ARTS, at 8.—The Timber Resources of the Australian Commonwealth: E. T. Scammell.

CHEMICAL SOCIETY, at 5.30.—(1) On the Preparation of Absolute Alcohol from Strong Spirit; (2) On the Vapour Pressures and Boiling-point of Mixed Liquids; (3) The Correction of the Boiling-points of Liquid from Observed to Normal Pressure: S. Young.—(1) On the Properties of Mixtures of the Lower Alcohols; (2) On the Properties of Mixtures of the Lower Alcohols with Benzene, and with Benzene and Water; (3) Fractional Distillation as a Method of Quantitative Analysis; (4) Vapour Pressures and Specific Volumes of Isopropyl Isobutyrate: S. Young and E. C. Fortey.—Nitrogen Bromides containing the Propionyl Group: F. D. Chattaway.

GEOLOGICAL SOCIETY, at 8.—The Origin and Associations of the Jaspers of South-eastern Anglesey: E. Greenly.—The Mineralogical Constitution of the Finer Material of the Bunter Pebble-Bed in the West of England: H. H. Thomas.—Revision of the Phyllocarida from the Chemung and Waverly Groups of Pennsylvania: Prof. C. E. Beecher.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:*—Coefficients of the Cubical Expansion of Ice, Hydrated Salts, Solid Carbonic Acid, and other Substances at Low Temperatures: Prof. J. Dewar, F.R.S.—The Conditions determinative of Chemical Change and of Electrical Conduction in Gases, and of the Phenomena of Luminosity: Prof. H. E. Armstrong, F.R.S.—On the Insulation Resistance of the Capillary Electrometer, and the Minimum Quantity of Electricity required to produce a Visible Excursion: G. J. Burch, F.R.S.

ROYAL INSTITUTION, at 3.—Recent Geological Discoveries: Dr. A. Smith Woodward, F.R.S.

LINNEAN SOCIETY, at 8.—(1) On the Mammalian Cerebellum, with special reference to the Lemurs; (2) On the Brain of the Elephant Shrew, *Macroscelides proboscideus*: Dr. Elliot Smith.—On the Early Condition of the Shoulder-Girdle in the Polyprotodont Marsupials, Dasyurus and Perameles: Dr. R. Brown.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Relay Translation for Long Submarine Cables: S. G. Brown.

RÖNTGEN SOCIETY, at 8.30.—The Relation between X-Rays and allied Phenomena in Light and Electricity: Ernest Payne. (*Discussion.*)

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Experimental Researches on the Constitution of Crystals: A. E. Tutton, F.R.S.

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